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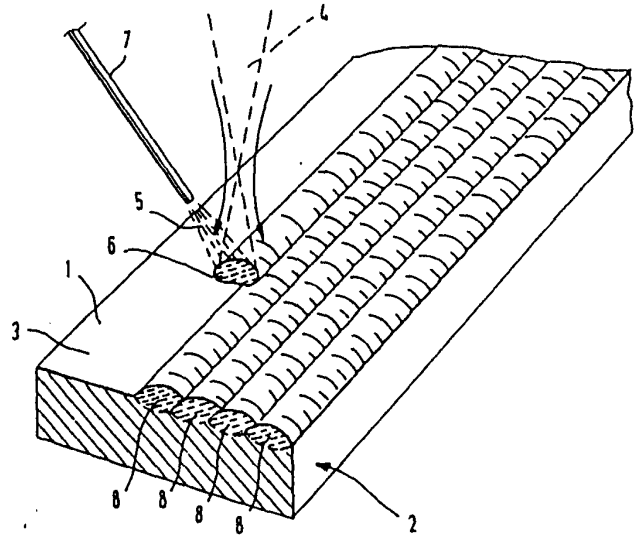
(54) Title: METHOD FOR WORKING SURFACES ON METALS



(57) Abstract

The present invention relates to a method for machining or working surfaces on metals, namely for creating surfaces with self-lubricating properties on metals (1) by providing a surface layer (B) which is homogeneous with the base metal and of lubricating character, whereby said surface layer of the metal is melted with high energy, e.g. a laser (4). This method is characterized by melting the surface layer (3) of the metal while at the same time adding a metal, metal alloy or metal mixture (5) in the form of molybdenum to the smelt (6), whereby a metal composite is obtained, consisting of substantially unchanged particles of the added molybdenum material in a matrix of the remelt base metal.

ref. (3)

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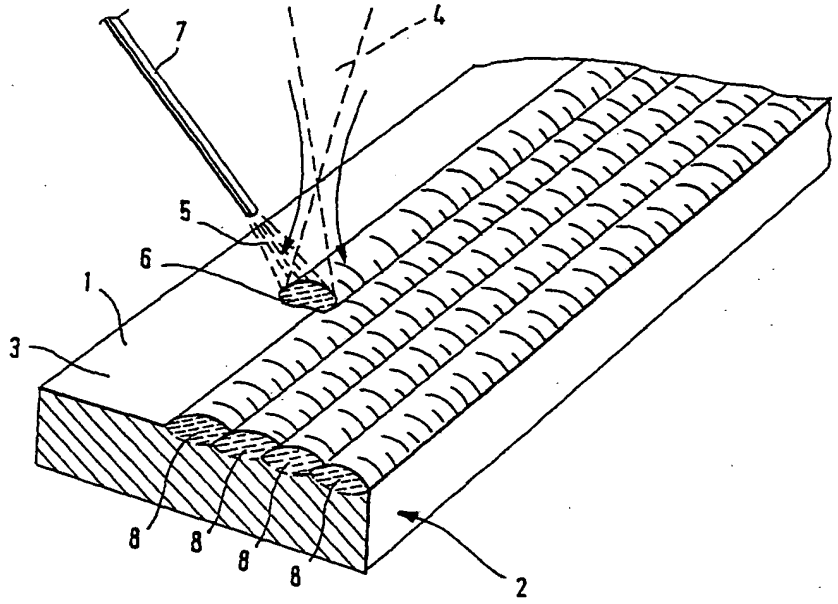

(57) Abstract

The present invention relates to a method for machining or working surfaces on metals, namely for creating surfaces with self-lubricating properties on metals (1) by providing a surface layer (B) which is homogeneous with the base metal and of lubricating character, whereby said surface layer of the metal is melted with high energy, e.g. a laser (4). This method is characterized by melting the surface layer (3) of the metal while at the same time adding a metal, metal alloy or metal mixture (5) in the form of molybdenum to the smelt (6), whereby a metal composite is obtained, consisting of substantially unchanged particles of the added molybdenum material in a matrix of the remelt base metal.

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Method for working surfaces on metals.

The present invention relates to a method for machining or working surfaces on metals.

It is already known to create surfaces with self-lubricating properties by immersing a sintered metal into a smelt of lead or tin. Thus, one obtains a matrix of the base metal on which the applied material, e.g. lead, has filled up the porosity provided between the grains. When loaded, the lead will be pressed out and form a lubricating layer between two surfaces which slide relative to each other. This technique is used commercially for e.g. various types of bearing seats.

It is also known to increase the wear resistance, in adhesive as well as abrasive wearing, of a metal surface by locally melting the metal surface with high energy and into the smelt add hard particles with good wear properties such as carbides, nitrides or borides. This technique is known from US-A-4 299 860 and is designated as laser impregnation, whereby a metal composite is created in the surface, consisting of substantially unchanged particles, e.g. titanium carbides, in a matrix of the remelted base metal.

It is also known to add to a smelt created e.g. by laser, various alloying materials, e.g. molybdenum, whereby a new alloy is created in the remelt area, so called recovery with laser.

The object of this technique is thus to add particles to the smelt which are dissolved, and in this way e.g. obtain a higher hardness or improved corrosion properties in the remelt area.

The object of the present invention is among other things to provide a surface layer which is homogeneous with the base metal and having lubricating character, by melting the surface layer with high energy, e.g. laser, while simultaneously adding a metal, metal alloy or metal mixture in the form of molybdenum to the smelt, whereby a metal composite is obtained consisting of substantially unchanged particles of the added molybdenum material in a matrix of the remelt base metal.

Unlike laser impregnation according to US-A-4 299 860 or recovery with molybdenum, molybdenum is here added such that the added molybdenum material remains essentially unchanged in the smelt. During relative sliding between the treated metal surface and an untreated metal surface, the molybdenum particles will as when using sintered metal according to the above, provide a "lubricating" effect between the two surfaces. An important advantage compared with US-A-4 299 860 and sintered metal is that the present invention minimizes the wear of the untreated surface and that the surfaces after treatment can be worked by conventional cutting operation and yet maintain the "lubricating" layer.

The present invention also allows for partial treatment of e.g. crankshafts, whereby the need for particular bearing metals such as copper-base bearing metal or sintered metal, is completely eliminated.

Thus, with the present invention there is obtained a surface layer of self-lubricating character and homogeneously connected with the base material without the risk for splintering thereof or loosening in another way. The base material gets, in other words, a surface layer with a prolonged self lubricating character between e.g. sliding metal surfaces which can be subjected to high loads without loosening of the surface layer.

The invention will be further described below with reference to the accompanying drawings in which

fig. 1 is a perspective view of a metal object, the surface of which has been treated according to the invention;

fig. 2 is a metallographic picture of an etched metal object which has been surface impregnated;

fig. 3 is a section through a surface impregnated surface;

fig. 4 is a section through a surface impregnated surface after levelling thereof;

fig. 5 is an example of two surface impregnated machine components, teeth;

fig. 6 is a perspective view of a metal object with an annular surface impregnating string;

fig. 7 is a perspective view of the metal object of fig. 6 during a wire sparking moment;

fig. 8 is a perspective view of a die provided by wire sparking of the metal object of fig. 6;

fig. 9 is a perspective view of a stamp simultaneously obtained by wire sparking of the metal object of fig. 6;

fig. 10 is a section through the upper part of the die and the lower part of the stamp of figs. 8 and 9;

fig. 11 is a section through a die which has been surface impregnated along bottom and end edges;

fig. 12 is a section through the die of fig. 11;

fig. 13 is a section through a die according to figs. 11 and 12 during a die sparking operation;

fig. 14 is a section through surface impregnated and die spark treated portions of a die according to figs. 10 and 11;

fig. 15 is a metallographic picture of an etched metal object which has been surface impregnated;

fig. 16 is also a metallographic picture of an etched metal object having been surface impregnated; and

fig. 17 is a section through the smelt in a treated surface.

In order to create or provide surfaces with self-lubricating properties on metal surfaces 1 on objects 2 of metal or another suitable material, the metal surfaces 1 are impregnated by melting the surface layers 3 thereof with high energy, e.g. laser beams 4, while simultaneously adding a metal, metal alloy or metal mixture 5 to the smelt 6, whereby a metal composite is formed after setting, consisting of a matrix of the remelt surface layer 3 and substantially unchanged grains/particles of the added material. The metal, metal alloy or metal mixture can be added to the smelt 6 from a reservoir (not shown) through a nozzle 7.

Fig. 2 shows, with a metallographic picture, a cross section through a metal object (SS 2258) which has been surface treated in accordance with the abovementioned method, wherein

pulverous molybdenum has been added to the smelt through a nozzle. From the picture it is apparent that the molybdenum particles have penetrated into the smelt, whereby a metal composite has been created consisting of substantially unchanged molybdenum particles in a matrix of the remelt base metal. The hardness of the molybdenum particles amounts to about HV 400 and for the remelt base metal to about HV 600.

As is apparent in more detail from fig. 17, the metal comprises, after working or machining, an unchanged base metal GM and a remelt base metal GMO with unchanged molybdenum grains MK.

The added material is molybdenum and eventually lead and eventually tin and eventually indium or combinations of these substances. An example of the latter is molybdenum disulfide or addition of molybdenum to a smelt including sulphur or addition of molybdenum and sulphur to a smelt for forming molybdenum disulfide therein.

The surface impregnation may be carried out partially on predetermined portions of the object 2 and surface treating strings 8 are formed by displacing the object 2 and laser beams 4 relative to each other. The surface treating strings 8 are preferably located so in relation to each other that a portion b of 2-50%, preferably 20-40% of the width B of one of the surface treating strings 8 is integrated with a portion b of 2-50%, preferably 20-40% of the width B of the other surface treating string 8 (see fig. 3). This arrangement ensures homogeneous properties of the treated metal surfaces 1 and gives an increased working allowance.

The surface treating strings 8 are further located relative to each other such that they permit subsequent treatment, e.g. grinding or sparking, without exposure of completely or partially untreated material between specific surface treating strings 8.

In order to further improve the wear resistance of the metal surface 1, a metal, metal mixture or metal alloy 5 as above and a wear resistent particle such as carbides or ceramics may be added to the smelt 6 at the same time. In this

way, a metal composite is obtained, consisting of "soft particles" of lubricating character and "hard particles" with high wear resistance in a matrix of the remelt base metal.

Furthermore, the surface treating strings 8 are preferably imparted a largest depth of penetration D in the metal surface of 0,1-5 mm.

When required, the surface impregnated metal surfaces are levelled (se fig. 3) and impregnated surfaces 9 with low friction and improved wear resistance are obtained.

The surface treating strings 8 are preferably disposed locally on such surfaces on objects, e.g. pressing tools, tools, teeth, which are particularly exposed to wearing, while other surfaces of the object preferably are kept free from surface treating strings 8. An example of where surface treating strings 8 preferably can be located for friction reducing purpose is shown in fig. 5, where surface treating strings 8 have been provided on curved surfaces 10 and teeth 11, 12.

For obtaining wear surfaces of desired dimensions and/or smoothness, the surface impregnated metal surfaces 1 may be spark machined. In certain cases it might be suitable to wire spark machine the metal surfaces, while it in other cases it is suitable to die spark machine said metal surfaces 1.

An example of wire spark machining of surface impregnated metal surfaces is shown in figs. 7-10. In these figures, there is shown an object 2, which on one metal surface has been impregnated locally along a contour line corresponding to an (e.g. circular) end edge 13 and/or 14 of a die 15 and/or a stamp 16 (and/or a punch), whereafter the die 15 and/or stamp 16 (and/or punch) are formed by wire spark machining along said contour line by means of a wire sparking aggregate 17. Surface impregnation of the metal surface 1 may in this case occur by providing along said contour line a surface impregnating string 8 of sufficient width T for a portion T1 of said width T to form a wear surface on the

die 15 while the remaining portion 12 forms a wear surface on the end surface of the stamp 16 (or punch), whereby a hole 18 in the die 15 for the stamp 16 (or punch) and the stamp 16 (or punch) are obtained in the same moment by wire spark machining along said (here circular or annular) contour line.

In figs. 11-14 there is shown an example of die spark machining of impregnated metal surfaces. In these figures there is shown as an example an object 2 in the shape of a schematically illustrated tool die with a countersink 19, the end edges 20, 21 and bottom edges 22, 23 of which are impregnated locally by being provided with surface treating strings 8, whereafter the surface impregnated edges are die spark machined to final dimensions. This can be done by means of a die sparking electrode 24 (see fig. 13) which is formed after the final shape and/or surface (see fig. 14) of the countersink 19 after the die spark machining.

The method according to the invention is not limited to what is defined above, but may vary within the scope of the following claims. As an alternative it can be mentioned that the melting of the surface layer may be carried out by means of other high energy than laser beams.

Claims:

1. Method for machining or working surfaces on metals, namely for creating surfaces with self-lubricating properties on metals (1) by providing a surface layer (B) which is homogeneous with the base metal and of lubricating character, whereby said surface layer of the metal is melted with high energy, e.g. a laser (4), characterized by melting the surface layer (3) of the metal while at the same time adding a metal, metal alloy or metal mixture (5) in the form of molybdenum to the smelt (6), whereby a metal composite is obtained, consisting of substantially unchanged particles of the added molybdenum material in a matrix of the remelt base metal.

2. Method according to claim 1, characterized by adding to the smelt (6) a metal, metal alloy or metal mixture in the form of tin and/or lead and/or indium or combinations of these substances.

3. Method according to claim 1 or 2, characterized by adding to the smelt (6) a metal, metal alloy or metal mixture in the form of molybdenum disulfide.

4. Method according to claim 2, characterized by melting molybdenum into a smelt (6) containing sulphur for forming molybdenum disulfide therein.

5. Method according to claim 2, characterized by impregnating the smelt (6) with molybdenum and sulphur for forming molybdenum disulfide therein.

6. Method according to claim 4 or 5, characterized by bringing the smelt (6) to contain 5-80 percent by volume of molybdenum.

7. Method according to any preceding claim, characterized by carrying out surface impregnation by locating surface treating strings (8) relative each other so that they extend partially integrated with each other.

8. Method according to claim 7, characterized in that a portion (b) of 2-5%, preferably 20-40%, of the width (B) of one of the surface treating strings

(8) is integrated with a portion (b) of 2-50%, preferably 20-40% of the width (B) of the other surface treating string (8).

9. Method according to claim 7 or 8, characterized in that a certain portion (b) of the width (B) of one of the surface treating strings (8) is integrated with as big or substantially as big a portion (b) of the width (B) of the other surface treating string (8).

10. Method according to any of claims 7-9, characterized by adding to the smelt (6) 0,01-80 percent by volume of particles in the form of carbides and/or ceramics and/or alloy substances.

11. Method according to any of claims 7-10, characterized by imparting a largest depth of penetration (D) of 0,1-5 mm of the surface treating strings (8) into said material.

12. Method according to any of claims 7-11, characterized by disposing the surface treating strings (8) substantially locally on such surfaces on objects (2), e.g. on pressing tools, tools or teeth, which are especially subjected to wear, while the remaining surfaces on said objects are kept free from surface treating strings (8).

13. Method according to any of claims 7-12, characterized by providing curved surfaces on the objects (2) with surface treating strings.

14. Method according to any preceding claim, characterized by spark machining the surface impregnated metal surfaces (1) in order to produce wear surfaces of desired dimension and/or suitable smoothness.

15. Method according to claim 14, characterized by wire spark machining the surface impregnated metal surfaces (1).

16. Method according to claim 15, characterized by surface impregnating the metal surfaces (1) locally along a contour line corresponding to an end edge (13 and/or 14) on a die (15) and/or a stamp (16) and/or a punch,

whereafter the die and/or stamp and/or punch are formed by wire spark machining along said contour line.

17. Method according to claim 16, c h a r a c t e r i z e d b y providing along said contour line a surface impregnating string (8) of sufficient width (T) for a portion (T1) of said width to form a wear surface on the end edge of a die, and the remaining portion (12) a wear surface on the end edge of a stamp (16) or a punch, whereby a hole (18) in said die (15) for the stamp (6) and/or punch and said stamp and/or punch are obtained in the same moment by wire spark machining along said contour line.

18. Method according to claim 14, c h a r a c t e r i z e d b y die spark machining the surface impregnated metal surfaces (1).

19. Method according to claim 18, c h a r a c t e r i z e d b y locally surface impregnating at least an end edge (20 and/or 21) and/or a bottom edge (22 and/or 23) of a countersink (19) in a tool die provided in said surface, whereafter the surface impregnated end edge and/or bottom edge are die spark machined to final size.

20. Method according to claim 19, c h a r a c t e r i z e d b y die spark machining the end edge (20 and/or 21) and/or bottom edge (22 and/or 23) of the countersink (19) by means of a die sparking electrode (24) which is formed after the final shape of the countersink after the die spark machining.

21. Method for machining or working surfaces on metals, namely for providing wear surfaces (1) on metal objects (2), e.g. on dies, stamps and/or punches in tools, whereby the wear surfaces are obtained by surface treatment, preferably surface impregnation of the metal object (2) by melting the surface layer (3) of said object by means of high energy, e.g. laser beams (4), while at the same time adding a metal, metal alloy or metal mixture or carbides or ceramics (5) to the smelt (6), c h a r a c t e r i z e d b y spark machining the surface treated surfaces (1) for obtaining desired dimension.

22. Method according to claim 21, c h a r a c t e r i z e d b y locally subjecting the portions of the metal object (2) to be spark machined to surface treatment.

23. Method according to claim 21 or 22, c h a r a c t e r i z e d b y wire spark machining the surface treated surfaces (1).

24. Method according to claim 23, c h a r a c t e r i z e d b y locally surface treating the metal object along a contour line corresponding to an end edge (13 and/or 14) on a die (15) and/or a stamp (16) and/or a punch to be formed by means of the metal object (2), whereafter the die and/or stamp and/or punch are formed by wire spark machining along said contour line, such that wear surfaces (T1, T2) are provided locally along the end edge of the die and/or stamp and/or punch.

25. Method according to claim 24, c h a r a c t e r i z e d b y providing along said contour line a surface impregnating string (8) of sufficient width (T) for a portion (T1) of said width to form a wear surface on the end edge of a die (15), and the remaining portion (12) a wear surface on the end edge of a stamp (16) or a punch, whereby a hole (18) in said die (15) for the stamp (6) and/or punch and said stamp and/or punch are obtained in the same moment by wire spark machining the metal object (2) along said contour line.

26. Method according to claim 21 or 22, c h a r a c t e r i z e d b y die spark machining the surface treated surfaces (1).

27. Method according to claim 26, c h a r a c t e r i z e d b y locally surface treating at least an end edge (20 and/or 21) and/or a bottom edge (22 and/or 23) of a countersink (19) in a tool die obtained by means of the metal object, whereafter the surface impregnated end edge and/or bottom edge are die spark machined to final size.

28. Method according to claim 27, c h a r a c t e r i z e d b y die spark machining the end edge (20 and/or 21) and/or bottom edge (22 and/or 23) of the countersink (19) by means of a die sparking electrode (24) which is formed

after the final shape of the countersink after the die spark machining.

29. Method according to any of claims 21-28, characterized by adding to the smelt (6) 0,01-80 percent by volume of particles in the form of carbides and/or ceramics and/or alloy substances.

30. Method according to any of claims 21-29, characterized by imparting a largest depth of penetration (D) of 0,1-5 mm of the surface treatment into said metal material.

31. Method according to any of claims 21-30, characterized by adding to the smelt (6) or forming in the smelt a lubricating substance for giving the surface of the surface treating strings (8) self-lubricating properties.

32. Method according to claim 31, characterized by adding a metal or metal mixture as lubricating substance.

33. Method according to claim 31 or 32, characterized by mixing molybdenum disulfide into the smelt as lubricating substance.

34. Method according to claim 31 or 32, characterized by melting molybdenum disulfide into the smelt as lubricating substance.

35. Method according to claim 31 or 32, characterized by melting molybdenum into a smelt (6) containing sulphur for forming molybdenum disulfide in said smelt (6).

36. Method according to claim 31 or 32, characterized by impregnating the smelt (6) with molybdenum and sulphur for forming molybdenum disulfide therein.

37. Method according to any of claims 33-36, characterized by providing the smelt (6) with 5-80 percent by volume of molybdenum.

38. Method according to claim 32, characterized by adding tin and/or lead and/or indium as lubricating metal substance.

39. Method for machining or working surfaces on metals,

namely by relative disposition of surface treating strings, formed by surface treatment, preferably surface impregnation, of a material (2) with laser (4) by locally melting the surface layer (3) of the material with the laser and simultaneously adding particles (5) to the smelt (6), which has other properties than said material (2), whereby adjacent surface treating strings (8) are located in relation to each other so that they extend partially integrated with each other for forming surface treating areas with homogeneous properties with regard to wear resistance and frictional reduction, characterized by subsequently machining or working said surface treating areas by grinding or sparking without exposing untreated material between separate surface treating strings (8).

40. Method according to claim 39, characterized by adding or forming a lubricating substance in the smelt (6) defining the surface treating strings (8) in order to give the surface of said strings self-lubricating properties.

41. Method according to claim 40, characterized by adding a metal or metal mixture as lubricating substance.

42. Method according to claim 40 or 41, characterized by mixing molybdenum disulfide into the smelt as lubricating substance.

43. Method according to claim 40 or 41, characterized by melting molybdenum disulfide into the smelt as lubricating substance.

44. Method according to claim 40 or 41, characterized by melting molybdenum into a smelt (6) containing sulphur for forming molybdenum disulfide in said smelt (6).

45. Method according to any of claims 39-44, characterized by disposing the surface treating strings (8) locally on such wear surfaces on objects, e.g. on pressing tools, tools or teeth, which are particularly subjected to

wear, while the remaining surfaces on said objects are left free from surface treating strings (8).

46. Method according to any of claims 39-45, characterized by spark machining surface treating areas (1) provided with integrated surface treating strings (8) for obtaining the desired smoothness and/or size.

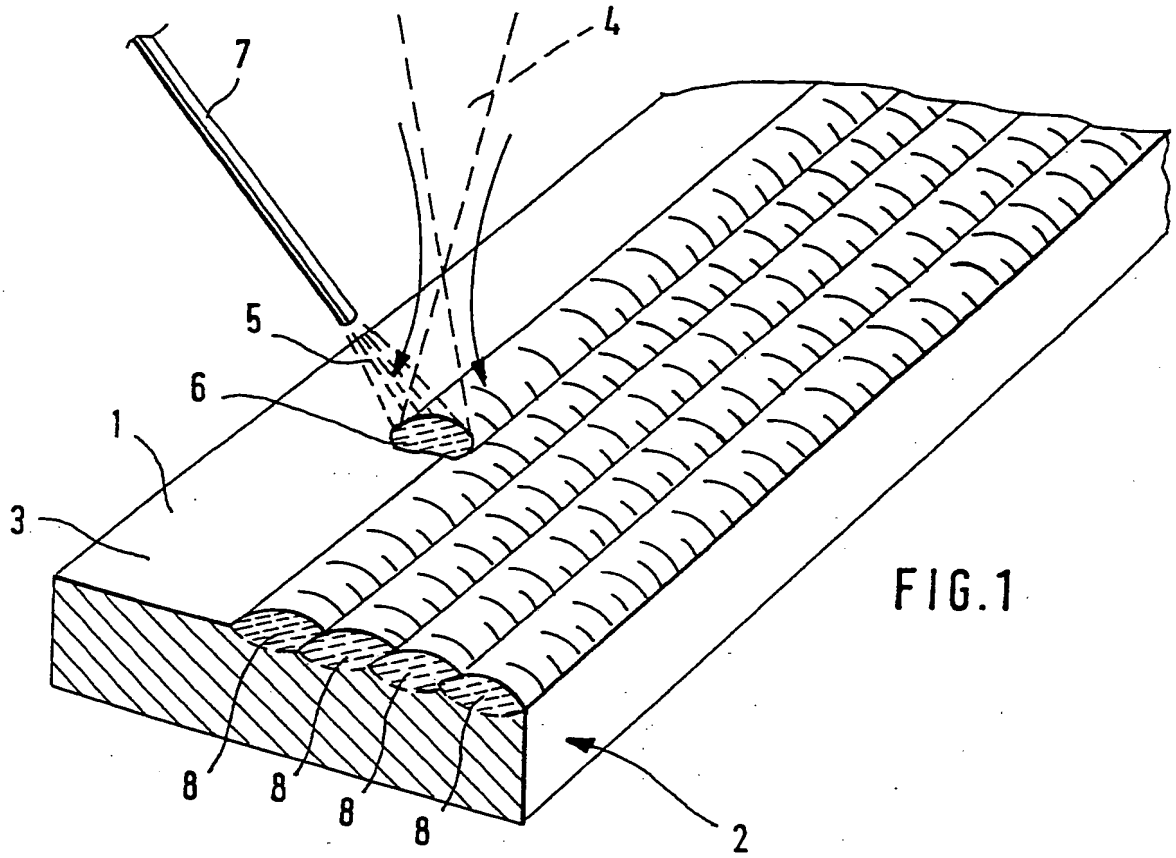


FIG.1

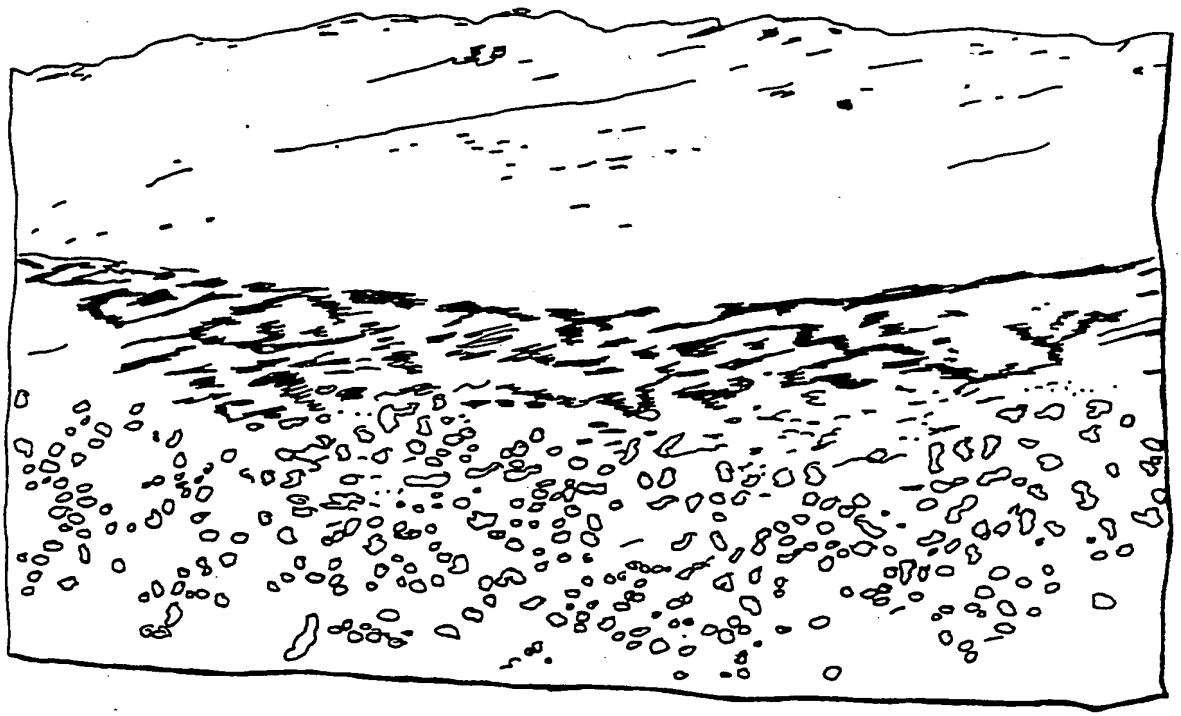


FIG. 2

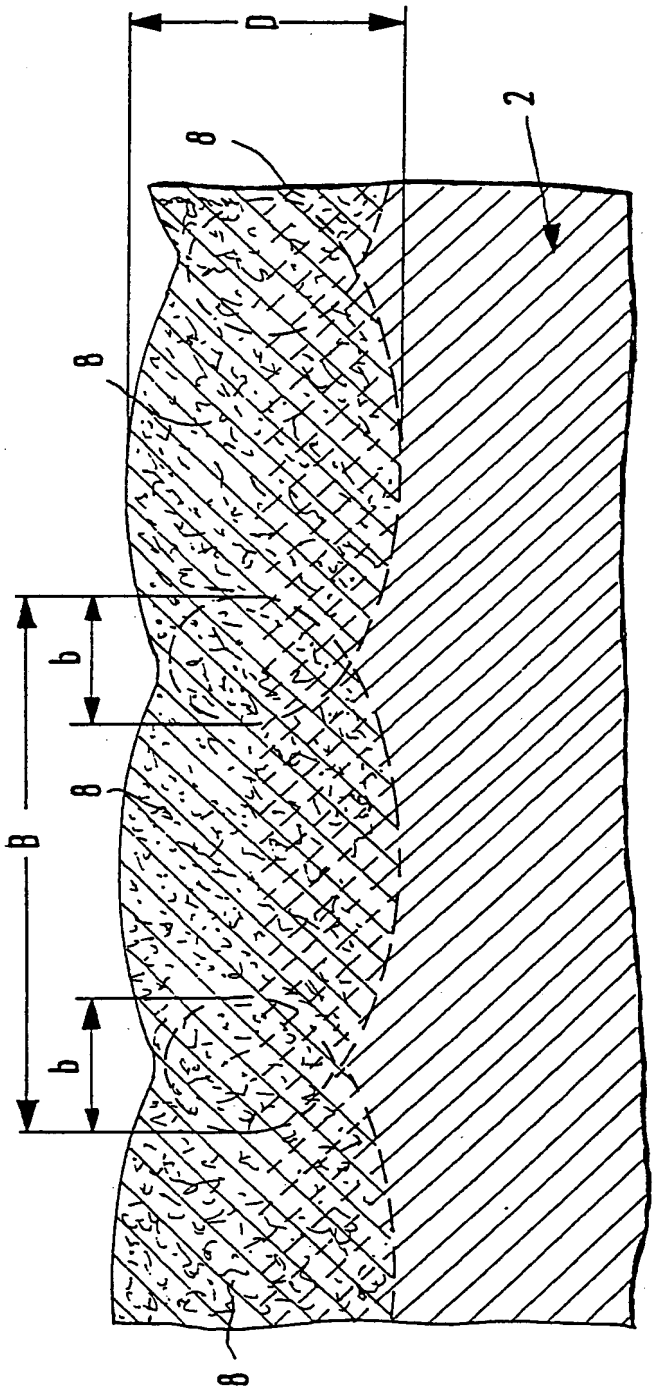


FIG. 3

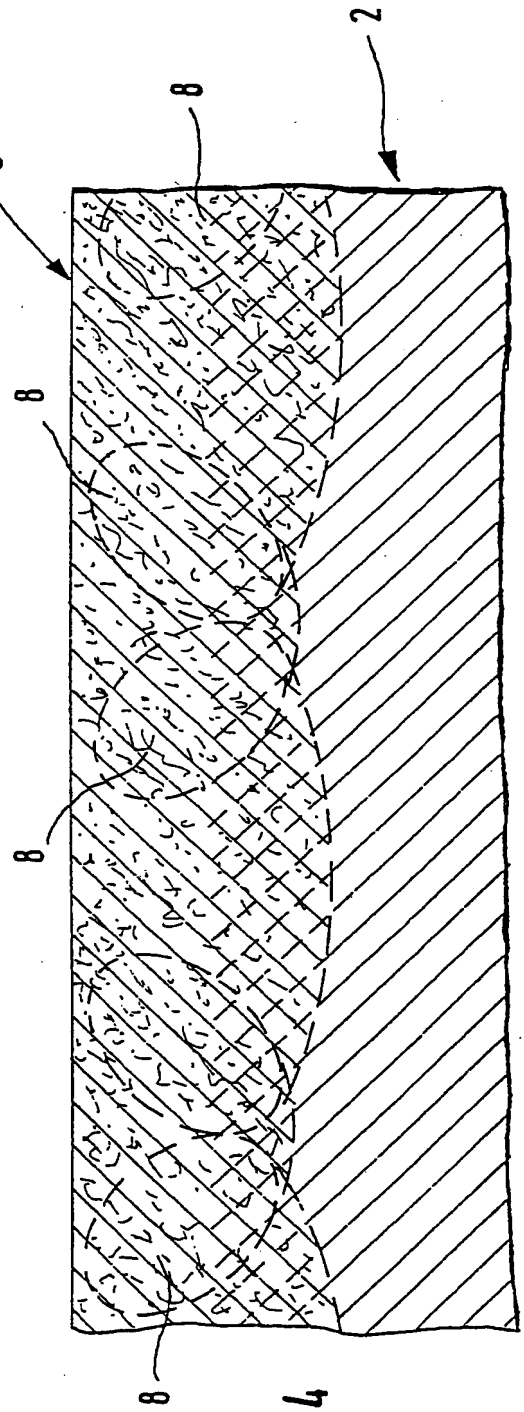


FIG. 4

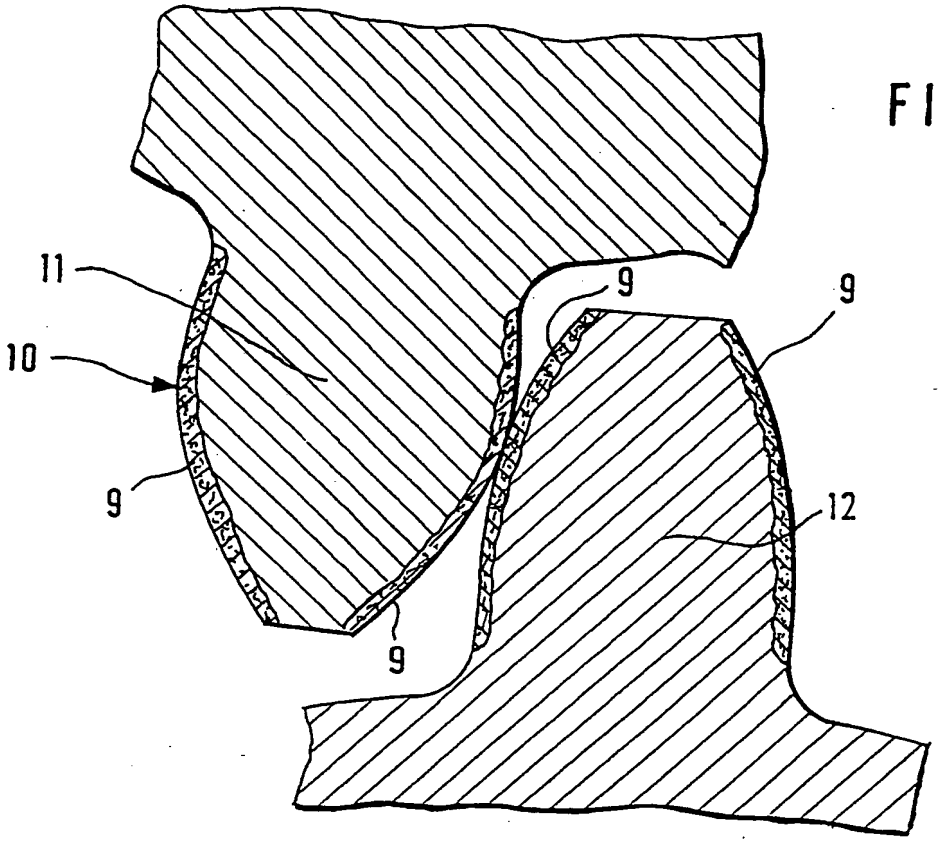


FIG.5

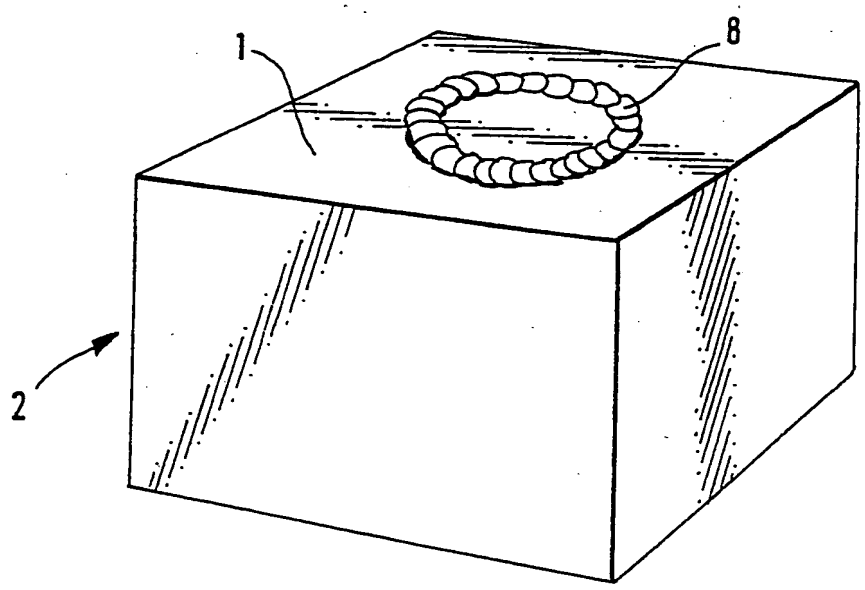


FIG.6

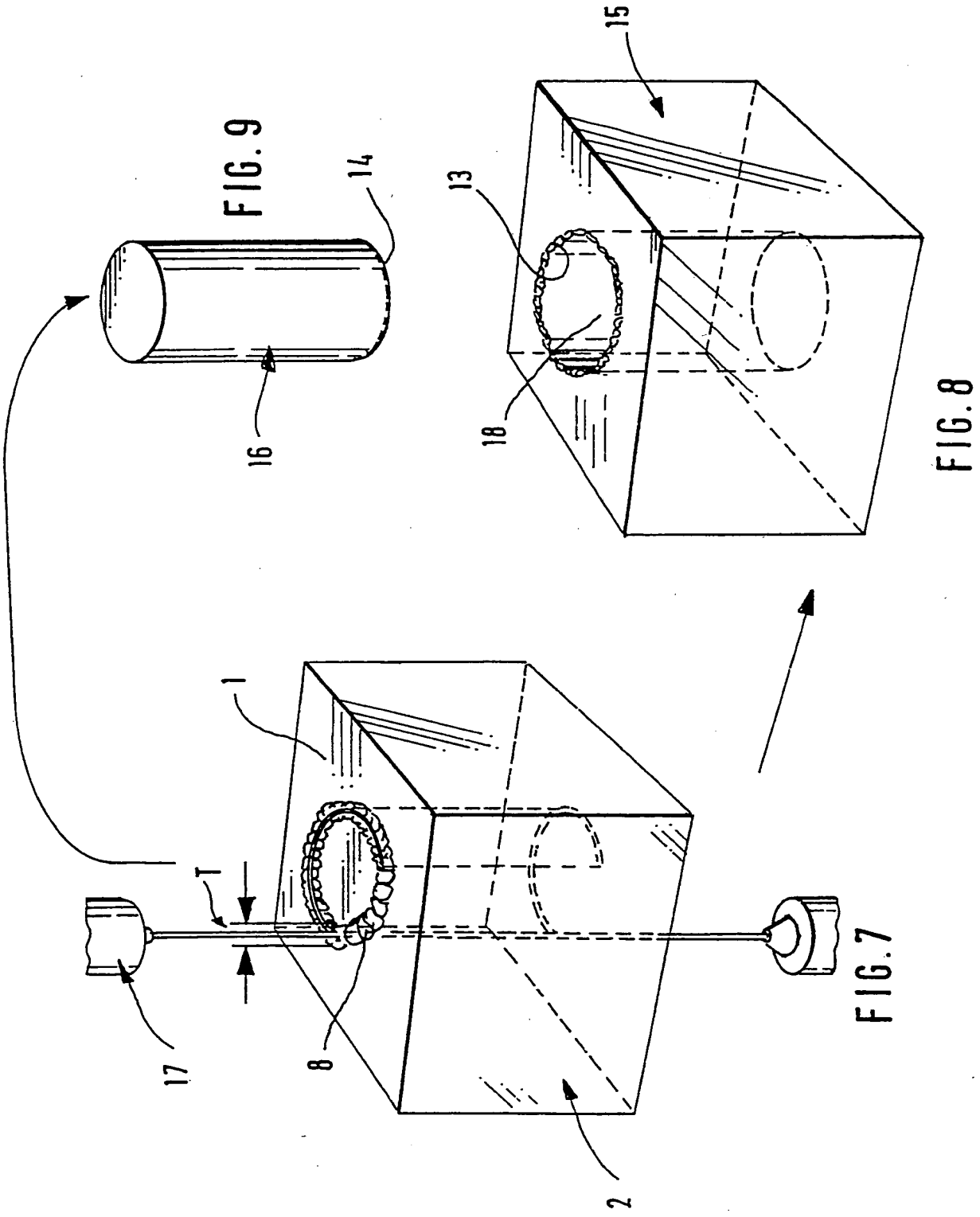


FIG. 9

FIG. 8

FIG. 7

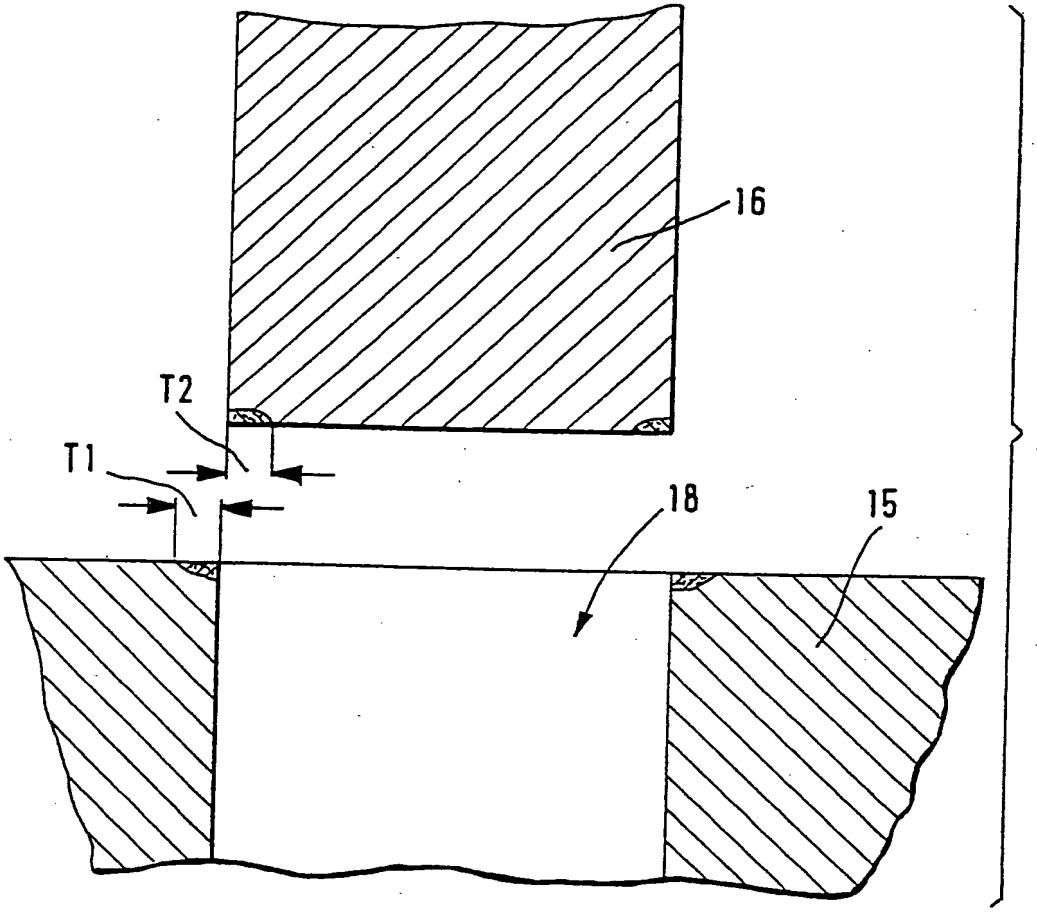


FIG.10

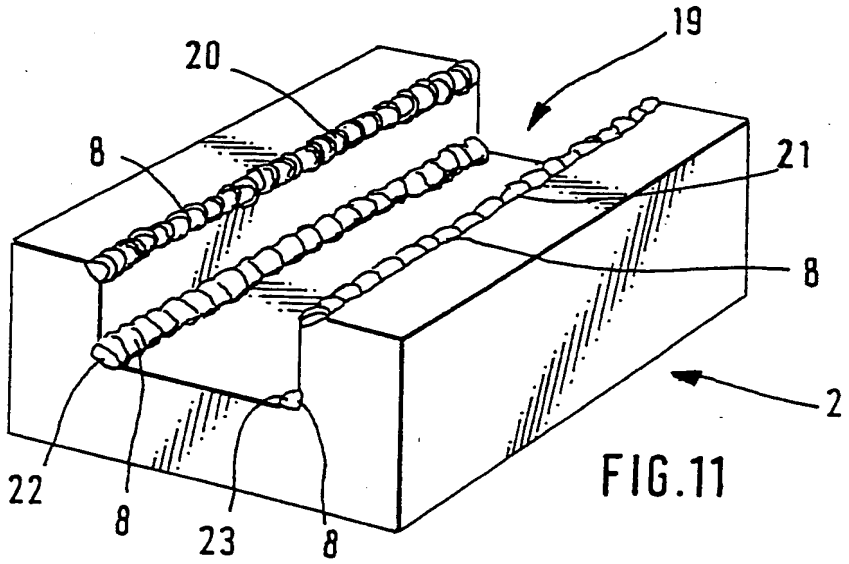


FIG.11

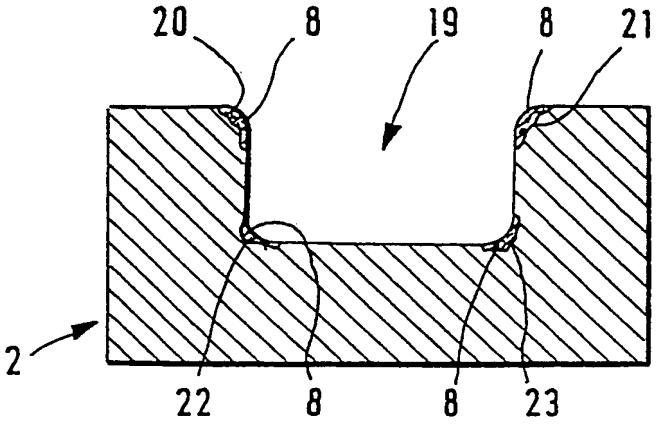


FIG.12

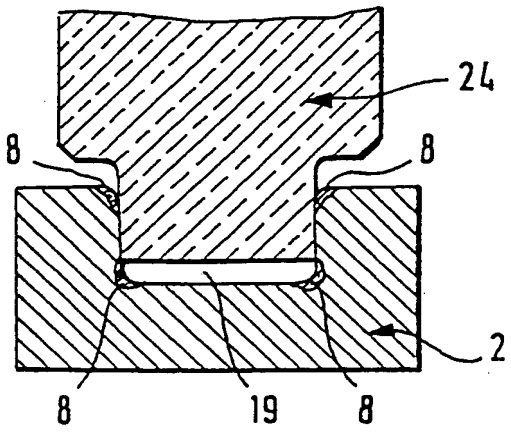


FIG.13

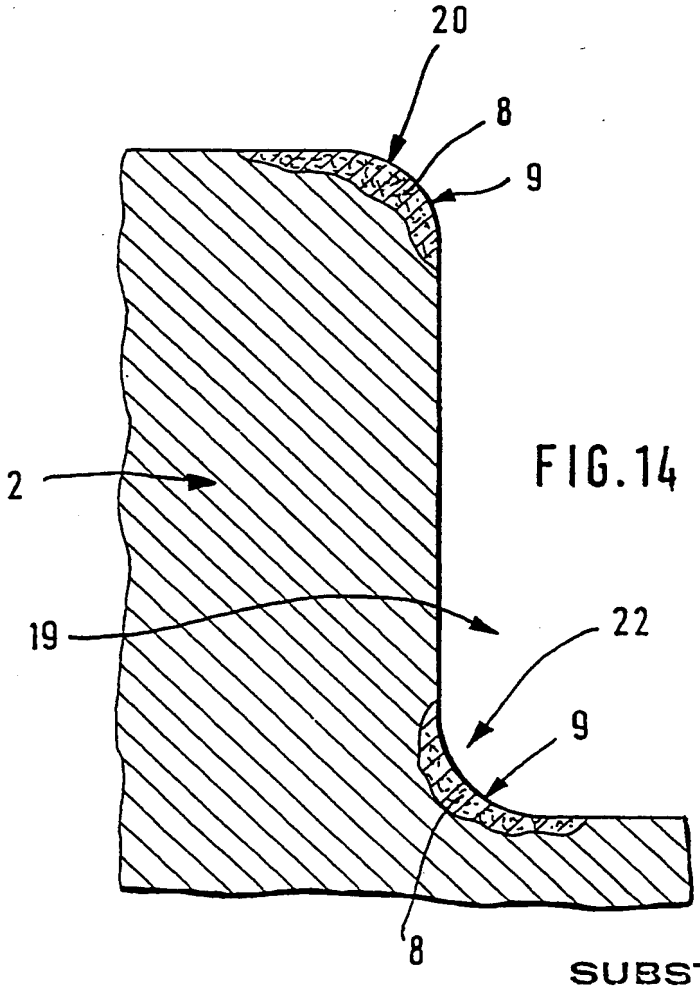


FIG.14

FIG. 15

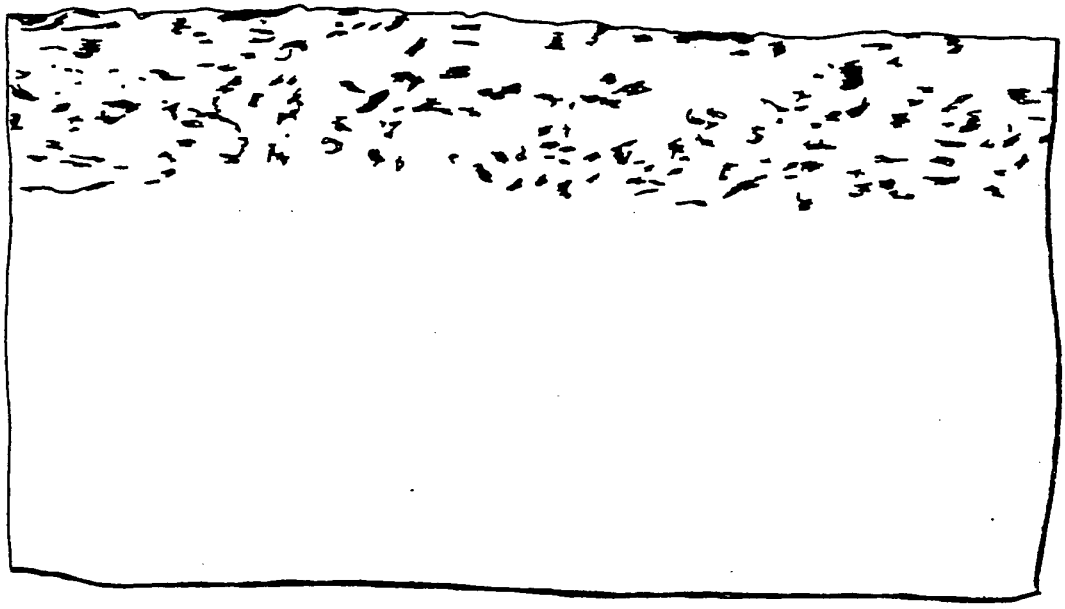
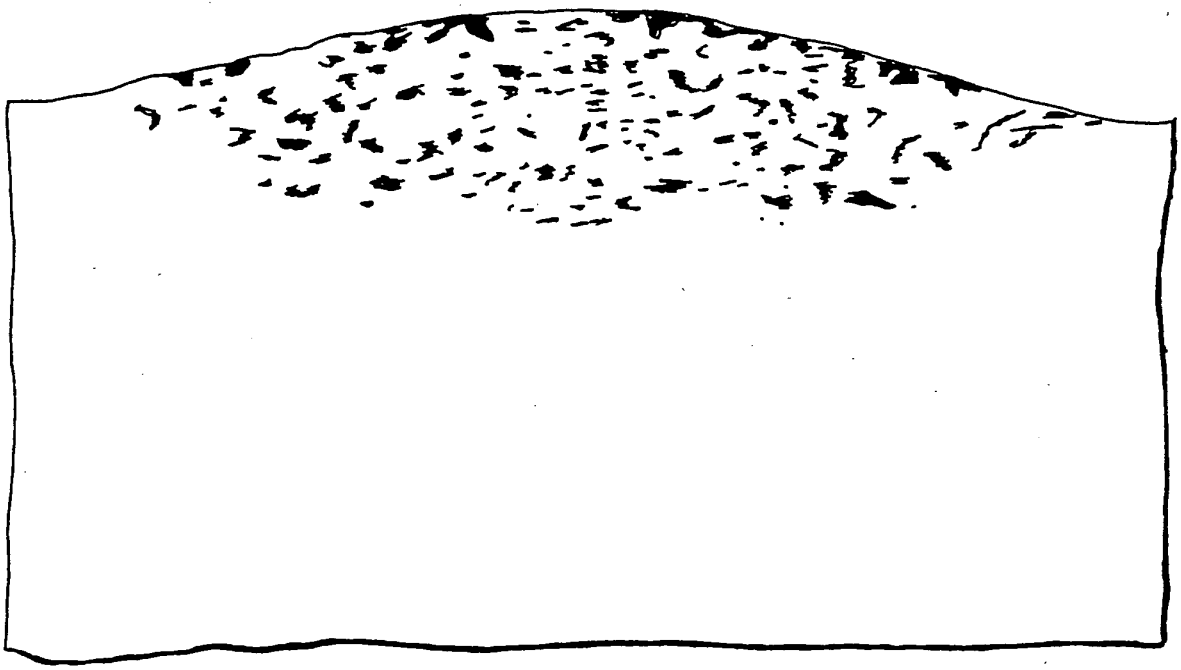


FIG. 16



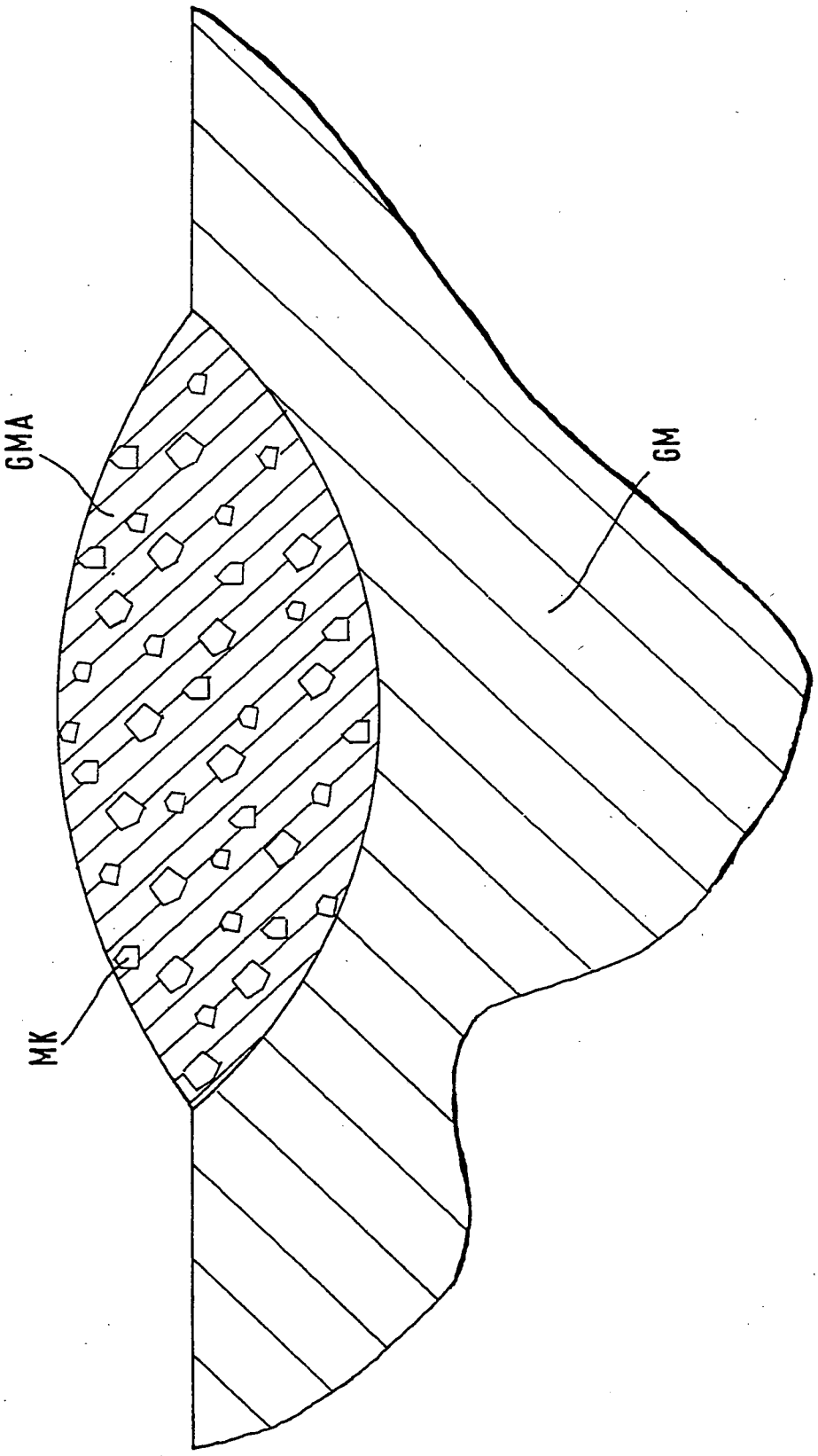


FIG. 17

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00203

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: C 23 C 24/00, 26/00, B 23 H 5/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	C 23 C; B 23 H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	DE, C2, 3433698 (HONDA GIKEN KOGYO K.K.) 11 June 1987, see column 2, line 47 - line 50; column 2, line 65 - line 67; column 3, line 41 - line 46; column 4, line 39 - line 42; figure 6; claim 2 examples 2, 7	1,3-6, 10,12
Y	--	1-46
Y	DE, C1, 3509582 (M.A.N. MASCHINENFABRIK AUGSBURG-NÜRNBERG AG) 20 February 1986, see column 3, line 4 - line 17; column 3, line 26 - line 44; claims 4,8	1,7-13, 21,22, 29,30, 39-46
	--	
X	DE, A1, 3635751 (HONDA GIKEN KOGYO K.K.) 23 April 1987, see page 4, line 49 - line 65; abstract; figure 3	1,3-6, 12,13
Y	--	1-46

* Special categories of cited documents:[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14th May 1991	[illegible] 5
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Ingrid Grundfelt

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	DE, C2, 3715327 (CASTOLIN S.A.) 21 September 1989, see column 1, line 51 - line 54 examples 2, 4 --	1,7-9, 11-13, 21-46
X	EP, A1, 0190378 (NIPPON STEEL CORPORATION) 13 August 1986, see page 5, line 16 - line 30; page 7, line 6 - line 11; page 12, line 4 - line 13; figures 8,9; claims 3,4	1,10,12, 13
Y	--	1-46
Y	GB, A, 1106794 (EBAUCHES S.A.) 20 March 1968, see claims 3,6 --	1-6,21, 31-44
Y	GB, A, 2052566 (ROLLS-ROYCE LIMITED) 28 January 1981, see page 2, line 39 - line 42 --	21,23-46
Y	Patent Abstracts of Japan, Vol 12, No 5, C467, abstract of JP 62-161966, publ 1987-07-17 (TOYOTA MOTOR CORP) --	1-6,21, 31-44
Y	VERKSTÄDERNA, Vol 67, September 1971, En konferens-rapport: "Modern teknik för pressverktygstillverk-ning", page 475 - page 476, see especially page 476, column 2, line 15 - line 23, column 3, line 19 - line 21 --	1,14,15, 21,23, 39,46
Y	Metals Handbook, 8th Edition, Vol. 3, 1967/1972, Ed. by Taylor Lyman et al, "Machining", Metals Park, Ohio 44073, Page 227 - page 233, page 257, page 280 - page 281, see especially page 230, column 3, line 1 - line 4, from the bottom; page 257, contents, lines 1 and 3; page 280, column 1, line 1 - line 4 --	1,14,18-21,26-28,39, 46
Y	Metalworking Production, February 1979, Special Report, "Electrical machining - the choice is yours", page 60 - page 65, "ECM/EDM-the machines and applications surveyed", page 70 - page 78, see especially page 71, column 1, line 33 - line 38; page 78, column 1, line 5 - line 18; figures 1, 3 and 4 --	1,14-20, 21,23-28,39, 46

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 91/00203

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 91-03-23
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C2- 3433698	87-06-11	FR-A- 2551770	85-03-15
		GB-A-B- 2148166	85-05-30
		JP-A- 60070136	85-04-20
DE-C1- 3509582	86-02-20	NONE	
DE-A1- 3635751	87-04-23	GB-A-B- 2183255	87-06-03
		JP-A- 62093314	87-04-28
DE-C2- 3715327	89-09-21	NONE	
EP-A1- 0190378	86-08-13	NONE	
GB-A- 1106794	68-03-20	NONE	
GB-A- 2052566	81-01-28	DE-A-C- 3011022	80-10-02
		FR-A-B- 2452528	80-10-24
		JP-C- 1295026	85-12-26
		JP-A- 55131164	80-10-11
		JP-B- 60013431	85-04-06
		US-A- 4269868	81-05-26
		US-A- 4300474	81-11-17